Inventions & Innovation Project Abstract

New Regenerative Cycle for Vapor Compression Refrigeration

This is a continuation of a Category 1 project, completed in August 2005. The main objective in this stage is to fabricate the prototype of the geothermal heat pump, working on the new thermodynamic cycle. This requires further research to increase the system efficiency to the level consistent with theoretical analysis of the cycle. Another group of objectives is to provide the foundation for commercialization and organization of the production facilities in order to achieve the original goal of first sales by the end of 2008. This includes documentation of the manufacturing process, preparing the business plan, organizing sales network and raising the private capital necessary to acquire production facilities.

The project involves the development of a novel vapor compression cycle with regenerative use of the potential energy of two-phase flow expansion, which in traditional systems is lost in throttle (expansion) valves. The potential energy of throttling is used for compression of the working medium vapor in a two-stage compression cycle. In our system, the compressor compresses the vapor to approximately 50-60% of the final pressure. Additional compression is provided in an ejector using internal potential energy of the working fluid. Therefore, the amount of mechanical energy required by a compressor is reduced and the efficiency is theoretically increased by up to 40%. The anticipated result will be a new refrigeration and heat pump system that requires less energy to accomplish a cooling/heating task. The application of this technology will be for more efficient designs of: 1. Industrial chillers, 2. Refrigeration plants, 3. Heat pumps, 4. Gas Liquefaction plants, 5. Cryogenic systems. It is estimated that the new technology will be capable of saving 78×10^{12} BTU in the geothermal heat pump sector from 2008 to 2016. Further, if used in all central air-conditioners in USA, the potential savings will amount to 4.7×10^{15} (quads) BTU from present through 2016.

In the first stage (Category 1) project we have succeeded in fabrication of the heat pump bench model and practically demonstrating 16% energy savings in the first attempt. These experiments clearly demonstrated the possibility of obtaining even better results through systematic analysis and further experimentation. This will be the subject for this proposed Category 2 investigations with final objective to develop the first commercial prototype in a relatively short time (2 years).

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